1. **Learning Objectives:**

The candidate will understand how to work with the variety of fixed income instruments available for portfolio construction.

**Learning Outcomes:**

(1h) Construct and manage portfolios of fixed income securities using the following broad categories:

- Managing funds against a target return
- Managing funds against liabilities

**Sources:**


Fabozzi Handbook of Fixed Income Securities, Chapter 2.

**Commentary on Question:**

*This question tests the ability of the candidate to construct liability hedging portfolios using a variety of physical fixed income instruments and derivatives*

**Solution:**

(a)  

(i) Calculate the dollar duration of both the portfolio and the liability.

(ii) Calculate the additional market value of Bond A required to immunize the portfolio.

**Commentary on Question:**

*The candidates performed above average on this section. Most candidates correctly calculated dollar duration and applied it appropriately. A few candidates incorrectly multiplied the answer by 100, or adjusted modified duration to Macaulay duration before performing the calculation; however, modified duration is the better approximation of the change in price of a bond due to interest rates.*

Dollar duration of liability: $100 million x 10% = $10 million
Dollar duration of assets: $75 million x 11 years /100 = $8.25 million
1. Continued

Additional MV of Bond A required: \((10 \text{ million} - 8.25 \text{ million}) / (11/100) = $15.9\) million

(b) Describe each of the two instruments your manager has suggested.

**Commentary on Question:**
The candidates performed as expected on this section. Most candidates could describe at least one of the instruments. Some candidates described a collateralized loan, rather than actually describing a repurchase agreement and or/identifying that it functions similar to a collateralized loan. Others described an interest rate swap instead of an interest rate future.

A repurchase agreement is a contract involving the sale of securities coupled with an agreement to repurchase the same security on a later date. Although legally a sale, the repo transaction functions the same as a collateralized loan. Repurchase agreement provides leverage to portfolio returns.

A futures contract is an enforceable contract between a buyer (seller) and an established exchange or its clearing house in which the buyer (seller) agrees to take (make) delivery of something at a specified price at the end of a designated period of time. Interest rate futures are contracts on short-term instruments (Treasury bills) and longer-term instruments (Treasury notes).

(c)

(i) Calculate the rate of return of the portfolio.

(ii) Calculate the dollar duration of the portfolio.

(iii) Calculate the size of the same repurchase agreement that would instead result in a dollar-duration-immunized portfolio.

**Commentary on Question:**
The candidates performed below average on this section. Candidates typically recognized that the return attributable to the repurchase agreement is the yield less the borrowing cost. However, many did not use that to calculate the return for the total portfolio. Many also did not consider the duration of the repurchase agreement when calculating the dollar duration of the portfolio.

<table>
<thead>
<tr>
<th>Loan Type</th>
<th>Borrowed funds (Bond B)</th>
<th>Owned Funds (Bond A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount Invested</td>
<td>$50,000,000</td>
<td>$75,000,000</td>
</tr>
<tr>
<td>$ return using 4.5% for Bond A, 3.0% for Bond B</td>
<td>$1,500,000</td>
<td>$3,375,000</td>
</tr>
<tr>
<td>Less repo rate/interest expense @ 2.0%</td>
<td>$1,000,000</td>
<td>0</td>
</tr>
<tr>
<td>Net profitability</td>
<td>$500,000</td>
<td>$3,375,000</td>
</tr>
</tbody>
</table>
1. Continued

Rate of return:
\[(\text{Income on Borrowed Funds} + \text{Income on Owned Funds}) / (\text{Market Value of Equity Funds}) = \frac{500,000 + 3,375,000}{75,000,000} = 5.167\%\]

Dollar duration of owned funds: $75 million \times 11 \text{ years} / 100 = $8.25 million
Dollar duration of borrowed funds: $50 million \times 7 \text{ years} / 100 = $3.5 million
Dollar duration of the liability (paying off the repo) = -1 \times $50 million \times 1 \text{ year} / 100 = -$0.5 million
Dollar duration of portfolio = $8.25 million + $3.5 million - $0.5 million = $11.25 million

Dollar duration of liability: $100 million \times 10\% = $10 million
Dollar duration of assets: $75 million \times 11 \text{ years} / 100 = $8.25 million
Dollar duration gap = $1.75 million
1.75 million / ($3.5 million – $0.5 million) = 58 1/3 %
58.333\% \times $50 million = $29.17 million

(d) Calculate the number of whole futures contracts required to immunize the client’s existing portfolio from interest rate risk relative to the liabilities.

**Commentary on Question:**
_Candidates performed below average on this section. Most candidates demonstrate knowledge that the hedging ability of a contract is related to the bonds that will be delivered, but many did not demonstrate knowledge that the bond that will be delivered is the one that is cheapest for the exchange to deliver. Other candidates failed to provide the number of contracts as a whole number as requested in the question and required in practice._

To determine the number of contracts, choose the cheapest to deliver.
Bond C is the Cheapest-To-Deliver (CTD) bond and should be used.
Dollar duration of CTD bond = ($1 million \times 10 \text{ years}/100) = $0.1 million
Number of futures required = [1.75million / 0.1 million] \times 1.1 = 19.25 \sim 19 \text{ or } 20 \text{ contracts}

(e) Describe four significant risks associated with the use of this bond portfolio to hedge the plan sponsor’s liability.
1. Continued

Commentary on Question:
The candidates performed as expected on this section. Most candidates could identify credit related risks (migration, default, general spread movements) and currency risk. Successful candidates identified that while the portfolio is dollar duration matched once accounting for the currency difference, the portfolio would still be exposed to non-parallel changes in interest rates. Some candidates indicated that investing in a Canadian bond would expose the sponsor to emerging market risk, which is not accurate given Canada’s status as a developed country with a AAA rating.

Yield curve risk - The proposed Canadian bonds are 20-year bonds, but the liability pays out in 10 years. The portfolio is subject to significant yield curve risk, i.e. changes in the shape of the yield curve.

Basis risk – Interest rates in Canada and the US are not completely correlated. A change in the liability will not relate to a direct change in this bond portfolio.

Currency risk – The principal will be repaid in CAD while the liability must be paid in USD, exposing the plan sponsor to currency risk.

Credit/Default risk – Due to the lower credit quality of the bond, the bond portfolio is exposed to credit risk (the risk that changes in credit spreads change the value of the portfolio) and default risk (the risk that the bond issuer defaults).

Liquidity risk – There is a timing difference between the cashflow of the bond and the liability. There is a risk that the bond cannot be sold in time at a fair value to support cash needs.
2. Learning Objectives:
1. The candidate will understand how to work with the variety of fixed income instruments available for portfolio construction.

Learning Outcomes:
(1a) Describe the cash flow of various corporate and sovereign bonds considering underlying risks such as interest rate, credit and event risks.

(1c) Demonstrate an understanding of cash flow patterns and underlying drivers and risks of non-agency mortgage-backed securities and commercial mortgage-backed securities.

(1f) Demonstrate an understanding of the cash flow patterns and risks of whole loan commercial mortgages.

Sources:

Fabozzi, Handbook of Fixed Income Securities, 8th 8Edition, Ch 24 (p503-505)

Miller & Geltner, Commercial Real Estate Analysis and Investments, 3rd Edition, Ch 16 (p384)

Commentary on Question:
This question tests the understanding of cash flows and risks of corporate bond and commercial mortgages.

Solution:
(a) Describe four advantageous features of issuing a Medium Term Note.

Commentary on Question:
The candidates performed below average on this section. Most candidates were able to identify that MTNs are liquid. Some candidates were able to identify that MTNs are flexible, but in most cases, they did not provide any explanation to support that statement.

MTNs are offered continuous to institutional investors by an agent of the issuer. MTNs are registered with the Securities and Exchange Commission (SEC), which gives a corporation sufficient flexibility for issuing securities on a continuous basis. MTNs can be issued with wide varieties of maturities of 9 months to 30 years or longer.
2. Continued

MTNs are highly flexible debt instruments that can easily be designed to respond to market opportunities and investor preferences. Structured MTNs with hedging swap allows the issuer to create structured notes with interesting risk/return features desired by a swath of fixed income investors.

(b) Compare and contrast three types of provisions that would provide this flexibility.

Commentary on Question:
The candidates performed above average on this section. Most candidates were able to identify at least two types of provisions, and some candidates combined fixed-price call provision and make-whole call provision together. Some candidates just listed the names of provisions without details therefore only received partial credit.

The mechanisms are Fixed-price Call Provision, Make-Whole Call Provision, and Sinking-Fund Provision.
Fixed-price and Make-whole call provisions give the issuer the right (option) to buy the bonds in whole or in part back before their scheduled maturity. Therefore, such bonds are issued at a lower price (higher yield) to compensate bondholders. While a sinking-fund provision requires that the issuer retire a certain face-amount each year, an accelerated sinking-fund provision allows the issuer to retire more than the amount stipulated for retirement. Fixed-price call provision uses a fixed price to buy back the issue (based on a schedule included in the indenture), while the make-whole call price is calculated as the present value of the bond’s remaining cashflows subject to a floor price equal to the par value. Since the make-whole call price floats inversely with the level of Treasury yields, this provision eliminates the motivation of pure refunding purpose and results in lower cost than fixed-price provision. Instead of one call price to retire the bond, sinking-fund provision requires the issuer to retire a specified portion of an issue before maturity by make periodic payments each year.

(c) Describe three types of deferred-coupon structures that meet this requirement.

Commentary on Question:
The candidates performed as expected on this section. Many candidates were able to list and explain at least 2 deferred-coupon structures. Some candidates listed the names of structures but did not provide details and therefore received partial credit.
2. Continued

Deferred interest bonds: do not pay interest for an initial period, typically from 3-7 years
Step-up bonds: do pay coupon interest but the coupon rate is low for an initial period and the increases
Payment-in-kind (PIK) bonds: give issuer an option to pay cash at a coupon payment date or give the bondholder a similar bond

(d) Explain the impacts of prepayment risk on cash flow patterns of mortgages.

Commentary on Question:
The candidates performed as expected on this section. Most candidates were able to identify the uncertainty in cash flows due to prepayment, however some candidates did not provide the detail explanations therefore received partial credit.

Prepayment is analogous to “call risk” and creates uncertainty with respect to the timing of investors’ cashflows. 
Prepayments based on lower interest causes the investors ability to benefit from appreciation in the bond price.
Changing prepayment speed owing to interest rate moves causes variations in the cashflow of mortgage pools, that will influence the total performance.
Changes in prepayment rates lead to negative convexity of price performance. 
Prepayment risk leads to extension, causing the price of mortgage or MBS to decline more than comparable fixed-maturity instruments at the prevailing level of yields increases. (Or in more details, when market yields increase, prepayments tend to slow, causing the average life and duration of mortgages or MBS to increase; while when market yields decline and bond prices increase, prepayment increase, mortgage shorten in average life and duration. As a result, the price performance tends to lag that of bonds without prepayment exposure when interests decline.)

(e) Recommend a type of commercial mortgage ABC should pursue.

Commentary on Question:
The candidates performed below average on this section. Many candidates did not recommend permanent loans. Some candidates identified the permanent loan as appropriate mortgage type to invest but failed to provide the rationale and thus received partial credit.

Permanent loans: long-term loans designed to finance a completed, fully operational income property.
Life insurance companies usually have longer duration liabilities, that requires long-term asset to match their future cash outflows with stable and dependable patterns.
3. **Learning Objectives:**

3. The candidate will understand the variety and assess the role of equities in investment portfolios. The candidate will demonstrate an understanding of the distinguishing investment characteristics and potential contributions to investment portfolios of the following major asset groups:
   - Real Estate
   - Public Equity
   - Private Equity
   - Infrastructure
   - Commodities
   - Hedge Funds

**Learning Outcomes:**

(3a) Understand how the behavioral characteristics of individuals and firms influence the dynamics of equity markets.

(3b) Demonstrate an understanding of the types of equity investments available for an investor’s growth allocation and their most important differences.

(3d) Demonstrate an understanding of the due diligence process for different types of equity investments.

(3e) Demonstrate an understanding of the basic concepts surrounding passive, active, and semi-active investing.

**Sources:**
Commercial Real Estate Analysis and Investment (3rd edition), by David M. Geltner, Norman G. Miller, Jim Clayton and Piet Eichholtz, Chapter 12

Addressing Built-in Biases in Real Estate Investment, by Neil Cable, Fidelity Investments Canada ULC

**Commentary on Question:**

*This question tests candidates’ understanding of the biases in real estate investing and possible workarounds. Overall candidates performed as expected on this question.*

**Solution:**

(a) Discuss the consequences of three behavioral biases in the excerpt.

**Commentary on Question:**

*Candidates did above average on this question. Most candidates were able to identify the behavior biases and describe at least one consequence of each bias.*
3. Continued

(In order to receive full marks, candidates need to identify the 3 biases and at least one consequence)

1. Home Bias: We generally prefer the familiar and are wary of what is foreign or new (familiarity bias). When we have to make a decision, we tend to choose the option with the most readily available information, even if some of the information isn’t necessarily useful (availability bias). Together they help to explain why many investors show a preference for investing in domestic assets.

2. Framing bias: The decision to label properties as ‘Core’ or ‘Core +’ is largely a subjective exercise based on the location and age of the building. The problem is that this means that we risk grouping assets together in a manner that implies a greater level of homogeneity than is actually the case. While they have some informational value, these labels typically do not take account of other influential drivers of real estate risk/return such as lease structure and tenant strength.

3. Anchoring bias: Prospective real estate buyers are also known to link their current valuations to past transactions, e.g. past 5 years. This helps to create a positive feedback loop which can put sustained upward pressure on asset prices.

(b) Propose an approach to address each of the behavioral biases you have identified in (a).

Commentary on Question:
Candidates performed as expected on this question. Most candidates were able to come up with some approach to address the biases, although few were able to get full marks.

(Candidates did not have to include everything shown below under each bias in order to get full marks)

1. Home bias: Ensure that portfolios are diversified across geographies. Diversify income streams, the attractiveness of which also depends on geography. Look abroad for more attractive valuations

2. Framing bias: Place particular emphasis on the level and sustainability of an asset’s rental income, which is the dominant - and least volatile - source of real estate returns. Diversify a portfolio primarily on the basis of tenant risk and lease structure. Give greater consideration to the underlying drivers of real estate performance.

3. Anchoring bias: In terms of asset valuation, place more emphasis on a property’s yield than its absolute price. Do not anchor to past economic growth rates or performance, as there is no guarantee that such performance will continue in the future. Instead, focus on property-specific factors that influence the income return
3. Continued

(c) Explain why the IV of a property may differ for different investors at the same point in time.

**Commentary on Question:**
Candidates performed as expected on this question. Many candidates were able to identify that different investors have different abilities to generate cash flow, though few candidates were able to get full marks.

Investment value (IV) of a property is its value to a particular owner, who would be owning and for operating the asset for a long period of time, and explicitly not planning to sell the asset for a long period of time. IV is defined with respect to a specified investor, and investors differ in their ability to generate and use future cash flow and value from the asset, so IV values may differ for different investors for the same asset as of the same point in time. IV is a private or subjective valuation of a party.

(d) With respect to the commercial property noted above:

(i) Calculate the IV.

(ii) Calculate the MV.

**Commentary on Question:**
Candidates performed brilliantly on this question. Most candidates were able to get full marks.

IV = $200,000 / 10% = $2,000,000
MV = 40% x $1,000,000 + 30% x $1,200,000 + 30% x $1,600,000
= $1,240,000

(e) In the same analyst report, the following is written:

*TWA has extensive research in a somewhat sluggish real estate market that we have witnessed predictable cycles of short-run movement in prices. We can take advantage of this predictability to attempt to buy low and sell high. We believe that in that real estate market, we have a greater opportunity for making successful market timing decisions.*

Critique the above excerpt.

**Commentary on Question:**
Candidates performed below average on this question. Many candidates were able to identify transaction cost as a reason the excerpt is incorrect, but few candidates were able to get full marks.
3. Continued

Real estate asset markets are far from completely predictable. Transaction costs in buying and selling assets directly in the property market are much greater than those in the securities market. Such costs can remove much of the profit investors could otherwise obtain from trading on predictable asset movements. Transaction costs can be mitigated by holding real estate investments for long periods of time. But long holding periods also mitigate the per-annum percentage profit that can be earned from timing the ups and downs of the market. Investment returns over long holding periods will often be more sensitive to how well the property is managed during the holding period than to the timing of when the property was bought or sold. At the individual property level, the randomness of transaction noise may swamp much of the advantage of market timing, or in any case can add greatly to the risk of short-term investments.
4. **Learning Objectives:**
4. The candidate will understand the nature, measurement and management of liquidity risk in financial institutions.

**Learning Outcomes:**
(4b) Measure and monitor liquidity risk, using various liquidity measurement tools and ratios.

**Sources:**
Quantitative Credit Portfolio Management, Ben-Dor, et.al., Ch 5 and 6

**Commentary on Question:**
*This question tests the concepts of liquidity and measuring of liquidity risk using liquidity cost score (LCS) and OAS decomposition.*

**Solution:**
(a) Assess how each of the above changes may have affected the portfolio’s LCS.

**Commentary on Question:**
Candidates performed as expected on this question. Most candidates identified how each factor impacts liquidity hence LCS scores. Most candidates assessed the first and third changes correctly. For the fourth change, almost half of the candidates thought the portfolio acquired the newly issued bond, and thus incorrectly answered “improved liquidity”. For second change, only a small fraction of the candidates gave the illustrated answer with many treating it as the same case as the first change.

**All bonds are one year older. No bonds have been bought, sold, or matured in the past year.**

As bonds age, they typically become less liquid and LCSs increase. This would likely increase the portfolio LCS.

As bonds age, their durations decrease. Assuming no changes in credit profile, these bonds would have lower DTS, which all else equal would lower LCS.

**One long-dated bond is approaching maturity within the next year.**

Long-dated bonds tend to become more liquid as they approach maturity, since investors may be reinvesting into longer duration bonds. This would likely lower the portfolio LCS.
4. Continued

The issuer for one bond has been downgraded by rating agencies. This has triggered high trading volumes from forced selling.

A rating downgrade suggests a deterioration in credit worthiness. This should lead to higher spreads and higher LCS.

High trading volumes often suggest lower LCSs.

A ten-year bond was previously the most recent issue. The issuer has recently issued new ten-year bonds.

This bond was likely a benchmark bond since it was the most recent issue with a 10-year maturity. Since there is now a more recent issue, it is no longer a benchmark bond. It may still be high volume bond, but without knowing trading volumes, it is likely that this would increase the portfolio LCS.

(b) Estimate a range for the Liquidity Cost Score (LCS) for bond D.

Commentary on Question:
Candidates performed as expected on this question. Almost all candidates noted Non-quoted and Non-Benchmark adjustment factors. However, not all of them were able to distinguish when and how to use them. Most candidates were also able to use “age, issue size and DTS” to determine the boundary of LCS for bond D, but only a fraction of the candidates were clear on the directional of the boundary (min and max).
A small fraction of the candidate incorrectly used unadjusted vs adjusted LCS as the min and max of LCS.

Bond D is younger than Bond B (5 years versus 6 years), has a higher issue size ($500M versus $300M), and has a lower DTS (500bps versus 700bps). All of this suggests that D should have a lower unadjusted LCS than Bond B. An estimated upper bound for the LCS for Bond D is (1.5 points)

$$
\text{Upper Bound} = \text{Bond B Unadjusted LCS} \times \text{Non-Quoted Adjustment Factor} \times \text{Non-Benchmark Adjustment Factor}
$$

$$
= \frac{\text{Bond B Ask Price} - \text{Bond B Bid Price}}{\text{Bond B Bid Price}} \times \text{Non-Quoted Adjustment Factor} \times \text{Non-Benchmark Adjustment Factor}
$$

$$
= \frac{100 - 95}{95} \times 1.35 \times 1.15 = 8.2\%
$$
4. Continued

Bond D is older than Bond C (5 years versus 3 years), has a lower issue size ($500M versus $800M), and has a higher DTS (500bps versus 400bps). All of this suggests that Bond D should have a higher LCS than Bond C. An estimated lower bound LCS for Bond D is (1.5 points)

\[
\text{Lower Bound} = \text{Bond C LCS} \times \text{Non-Quoted Adjustment Factor} \times \text{Non-Benchmark Adjustment Factor}
\]

\[
= \frac{\text{Bond C Ask Price} - \text{Bond C Bid Price}}{\text{Bond C Bid Price}} \times \frac{\text{Ask Price} - \text{Bid Price}}{\text{Bid Price}}
\]

\[
= \frac{106 - 102}{102} \times 0.135 \times 1.15 = 6.1\%
\]

We estimate that the LCS for Bond D is between 6.1% and 8.2%.

(c) Identify which bonds (if any) should be liquidated so that the portfolio is compliant with the investment policy

**Commentary on Question:**
Candidates performed above average on this question. Most candidates calculated the LCS of Bond A, B, C in part (b), and used them to make correct decisions. Points were still given on Bond D based on the answer candidates determined in part (b) even if part (b) is incorrect.

To determine whether Bonds A, B, and C are compliant, we need to calculate LCS scores. Bond B needs to be adjusted since it is not a benchmark bond.

\[
\text{Unadjusted LCS} = \frac{\text{Ask Price} - \text{Bid Price}}{\text{Bid Price}}
\]

Bond A: \[
\frac{114 - 110}{110} = 3.6\%
\]

Bond B: \[
\frac{100 - 95}{95} \times 1.15 = 6.1\%
\]

Bond C: \[
\frac{106 - 102}{102} = 3.9\%
\]

We estimate that Bond D’s LCS is higher than the required 6% LCS, so it should be sold. Bond B also has an LCS>6%, so it should also be sold.
4. Continued

(d) Recommend bonds (if any) to be added to the portfolio.

**Commentary on Question:**
Candidates performed as expected on this question. Very few candidates answered the question as illustrated. Many candidates used the OAS to back out an estimated LCS, and compared with observed LCS based on (bid-ask spread). However about half of those candidates made the correct decision. Almost all candidates used OAS regression model to determine the LCS, and determined Y is ruled out.

We should recommend bonds that are undervalued and have LCSs that meet the investment policy.

To assess relative value, we will use OAS decomposition and compare observed OASs against estimated OASs. (2 points) First, we calculate LCSs for the bonds. Only Bond Y requires adjustment since it is not a benchmark. Since the indicative bid-ask spreads are available for all bonds, no non-quoted adjustments are needed.

\[
\text{Bond X: } 40 \times 7 = 280 \text{ bps}
\]
\[
\text{Bond Y: } 90 \times 6 \times 1.15 = 621 \text{ bps}
\]
\[
\text{Bond Z: } 100 \times 4 = 400 \text{ bps}
\]

Bond Y can’t be recommended since it’s LCS>6%.

Now we use the regression model to estimate OASs from expected default costs and liquidity costs. We can focus on X and Z since Y has been ruled out.

\[
\hat{\text{OAS}}_i = \hat{\alpha} + \hat{\beta} \times CDS_i + \hat{\gamma} \times LCS_i
\]

\[
\text{Bond X: } 100 + 1.2 \times 150 + 0.7 \times 280 = 476 \text{ bps}
\]
\[
\text{Bond Z: } 100 + 1.2 \times 200 + 0.7 \times 400 = 620 \text{ bps}
\]
We recommend bond X be added to the portfolio since its current OAS is greater than the OAS suggested by the decomposition model (500 bps versus 476 bps).

If candidates back out estimated LCSi from OAS, then compare with observed LCSi (based on bid-ask spread). When former is higher than the latter, decision is to buy. All credit can be given too.
4. Continued

If candidate calculate the error factor, and used it to determine bond richness, all credit can be given too.

No points were given if use the size of LCSi, not the relative size of the LCSi, to make determination.
5. **Learning Objectives:**

2. The candidate will understand:
   - The credit risk of fixed income portfolios, securities, and sectors and be able to apply a variety of credit risk theories and models.
   - How rating agencies rate corporate and sovereign bonds and securitized credit.

**Learning Outcomes:**

(2g) Demonstrate an understanding of credit default swaps (CDS), including the use of CDS in a portfolio context

**Sources:**

Fabozzi HFIS 8th Edition Ch 66

**Commentary on Question:**

*This question tests the concept of credit default swap and its application to hedging credit risk on an asset portfolio.*

**Solution:**

(a)

(i) Describe two situations in which an investor would purchase CDS protection.

(ii) Describe two situations in which an investor would sell CDS protection.

**Commentary on Question:**

*The candidates performed as expected on this section. The candidates were successful at providing at least one situation when an investor would sell and purchase CDS protection. A common mistake was not listing two situations for each, purchase and sell CDS protection.*

- Transferring credit risk: CDS are first and foremost a tool used to transfer credit risk from one party to another. For example, banks can use CDS to transfer loan credit risk off their balance sheets into the capital markets where this risk may be assumed by an investor. This creates new loan capacity on their balance sheet.
- Hedge credit risk: Before the advent of CDS, it was difficult to hedge an existing credit risk by shorting corporate bonds. Buying protection using a CDS is a much easier way to achieve the same objective. CDS
- Indices can also be used as a hedge against changes in the marketwide pricing of credit risk and also the default of individual reference entities.
- Customization: As the CDS market is a bilateral OTC market, parties can structure the features of a CDS in almost any way they wish. Features that can be varied include the currency, maturity, and seniority. The more the customization deviates from the market standard, the greater the associated cost and the lower the subsequent liquidity.
5. Continued

- Ease: A CDS index makes it simpler for an investment manager to assume an exposure to a diversified portfolio of credits in one transaction. The tight bid/offer spread also makes the cost of unwinding the position cheaper than the cash equivalent.
- Leverage and yield enhancement: A CDS and a CDS index typically require only a small upfront payment. This makes it easier to leverage the underlying risk and return compared to a fully funded cash bond.
- Pure credit play: The CDS and CDS index are almost a pure credit play since unlike fixed-rate corporate bonds, they have very little interest rate sensitivity. This isolation of the credit risk is attractive for credit fund managers.
- Risk decomposition: CDS can be used to hedge out specific risks in securities with multiple risks. For example, they can be used to hedge 1546 PART 9 Derivatives out the credit risk of convertible bonds in an attempt to isolate the economics of the embedded equity option.
- Speculation: CDS enable market participants to express a positive or negative view on an underlying credit while a CDS index makes it possible to go long or short macro-level credit.
- Structured credit investments: CDS can be used as the building blocks for more exotic structured credit investments that are created to provide a more tailored risk-return profile to specific types of investor.
- Manage regulatory capital: Banks can use CDS to hedge credits that have a high regulatory capital charge, provided such a hedge is recognized as being economically effective by regulators.

(b) Explain the “delivery option” for the protection buyer (long position) in the CDS market.

**Commentary on Question:**

The candidates performed below average on this section. The candidates were successful at identifying that the buyer has the right to choose which bond is protected. Candidates commonly missed identifying a soft credit event and restructuring clauses.

[Full credit could be obtained with a full description of at least two of the items below.]
- CDS contract protects the buyer from default of a basket of deliverable obligations rather than a specific obligation
- protection buyer has the right to choose which bond is protected by the contract, and is therefore long a delivery option.
5. Continued

- Option created under soft (restructuring) credit event - Protection buyer can choose which obligations they wish to deliver from a basket of possible deliverables. If the debt obligations held by the protection buyer are not the cheapest to deliver, it will be economically preferable to sell these in order to buy the cheapest to deliver, gaining the price difference as a windfall gain.
- Conseco debt restructuring example – investors with shorter-term loans and holding CDS protection were able to sell the loans for close to par, and purchase deep discount bonds that could be delivered under the CDS for par – windfall gain
- Restructuring clauses restricting deliverables:
  - Old-re - only 30-yr limit on maturity
  - Mod-re - tied to CDS termination date and/or restructuring event
  - Mod-mod-re – similar to mod-re but wider window (60mos) for restructured obligations vs 30 for non-restructured
  - No-re – restructuring not included in the list of credit events

(c) Describe the main objectives of the auction process.

Commentary on Question:
The candidates performed as expected on this section. The candidates were successful at stating recovery price is the same. Candidates commonly missed identifying a soft restructuring credit event.

[Full credit can be obtained by listing each objective along with its key elements.]
The main objectives of the auction process are as follows:
1. To be able to handle cases in which the notional of protection bought approaches or exceeds the total outstanding notional of deliverable obligations. In this case there can be a short squeeze as protection buyers who do not own deliverables attempt to buy these obligations in order to settle their contracts. In the past this has led to the prices of deliverable obligations to rise after the credit event as protection buyers rush to buy them in order to deliver them.
2. To ensure that the recovery price is the same across the entire CDS market. This is necessary if market participants who are both long and short protection to the same maturity on a reference credit are to be sure that they will be hedged. This requires a common recovery price to be set via a public auction procedure described below.
3. To handle the soft restructuring credit event. Recall that hard credit events cause all of the pari passu debt obligations to trade at the same price. However following restructuring credit events the debt obligations continue to trade with a term structure and the value of this delivery option led to the introduction of the Mod-Re and Mod-ModRe restructuring clauses as described earlier. The auction needs to be able to handle these restructuring clauses.
5. Continued

(d) Explain to your manager why each counterparty would prefer the other side to trigger a CDS in a restructuring event.

**Commentary on Question:**

The candidates performed below average on this section. The candidates were successful at stating triggering is asymmetric. Candidates commonly missed identifying the reason for the asymmetric event.

The triggering of a contract following a restructuring credit event is not automatic. In fact it is actually asymmetric in the sense that the basket of deliverable obligations depends on which party, if any, is the first to trigger the contract. The rules are as follows:

- If the contract is triggered by the protection buyer, then the basket that applies is the one that corresponds to the scheduled termination date of the CDS contract.
- If the contract is triggered by the protection seller, then the basket that applies is the longest maturity (30-year) basket.
6. **Learning Objectives:**

6. The candidate will understand:
   - Investment dimensions of designing product offerings and managing inforce product liabilities.
   - Managing investment portfolios in the context of financial institution liabilities (asset liability management).
   - The theory and techniques of portfolio asset allocation.

**Learning Outcomes:**

(6c) Demonstrate an understanding of liability driven investing (LDI) for pension plans

**Sources:**
LDI Explained - 2017 Final

**Commentary on Question:**
This question tests the ability of the candidate to demonstrate an understanding of liability driven investing (LDI) for pension plans.

**Solution:**

(a) Explain the two main unrewarded risks pension schemes face.

**Commentary on Question:**
The candidates performed as expected on this section. Many candidates successfully explained two unrewarded risks, while some other candidates identified rewarded risks and received no point. Full points were given only to the candidates who identified the risks and properly explained them.

(1) Interest rate risk: the present value of a scheme’s liabilities depends on the discount rate/interest rate. This value can change independently of changes in the scheme’s asset value, giving rise to interest rate risk.

(2) Inflation risk: A proportion of a scheme’s liabilities will be linked to inflation, so changes in inflation will affect the amount a scheme pays out when a liability falls due.

(b) Identify instruments that can be used in an LDI strategy to address unrewarded risks.

**Commentary on Question:**
Candidates performed below average on this section. In order to receive full points, the candidates needed to correctly identify at least four instruments. Candidates received partial points for identifying only 1 or 2 instruments.
6. **Continued**

(1) Instruments to address interest risk: interest rate swap, interest rate futures (bond futures), interest rate derivatives (caps/floors), bond, and other reasonable answers.

(2) Instruments to address inflation risk: inflation swap, inflation-linked bonds (TIPS), total return swap, and other reasonable answers.

(3) Other proper answers were accepted as well, for example, longevity swap (address longevity risk).

(c) Rank the three options in their ability to efficiently achieve the firm’s goal. Justify your answer.

**Commentary on Question:**
Candidates performed below average on this section. Most candidates received partial points because they did not provide sufficient and appropriate justification for the rankings they provided. Many candidates did poorly on this question because they missed the fact that the company specializes in equity investment. Some candidates did not answer the question in relation to “the ability to achieve the firm’s goal”.

Option B is the best strategy: the strategy is good since it gives great return by investing in equity and may improve funding status. In addition, it leverages the firm’s expertise on equity investment.

Option C is the second-best strategy: the strategy is good since it better hedges interest rate risk by investing 100% in bond while still get equity exposure for higher return, but this strategy gives up the firm’s equity investment expertise.

Option A is the worst strategy since it sells down growth assets which makes the goal of achieving 100% funding ratio less possible.

(d) Compare and contrast the portfolio structure (Pooled funds, Segregated Portfolio, Bespoke fund) under the two approaches being considered by the board.

**Commentary on Question:**
Candidates performed below average on this section. Almost half of the candidates did not successfully identify the key differences between three portfolio structures and received no point. Many other candidates did not receive full points because they did not speak to the two approaches (2.5 times and 4 times leverage levels) mentioned in the question.
6. Continued

Pooled fund co-mingles multiple investors to benefit from economies of scale. Client have flexibility to tailor their level of leverage only up to that offered by the funds. No custodian is required. Less operational burden and more cost efficiency. Usually good for lower level of leverage and is recommended for the first approach (2.5 times).

Bespoke fund is a fund wrapper set up for the exclusive use of a single client. This portfolio structure is highly customized as the client dictates all investment parameters. Custody is provided within the fund so there is less governance burden. The operational costs may be higher while the additional benefits may worth it. A desire to get the portfolio up and running quickly may steer a client towards a bespoke fund. Bespoke fund is recommended for a higher level of leverage, so it is recommended for the second approach (4 times).

Segregated portfolio allows for a high degree of tailoring, but a custodian is required which creates a higher governance burden. This portfolio structure is not recommended.
7. Learning Objectives:
7. The candidate will understand the need for and goals of attributing the performance of a portfolio to various factors, evaluating this attribution against a benchmark, and recommending adjustments to portfolio strategy.

Learning Outcomes:
(7a) Describe and assess performance measurement methodologies for assets portfolios

(7b) Describe and assess techniques that can be used to select or build a benchmark for a given asset, portfolio

Sources:
Determinants of Portfolio Performance, Brinson, Hood and Beebauer

Commentary on Question:
This question tests a simplified framework, developed in the source paper mentioned above, that can be used to decompose total portfolio returns. The goal was to compare the performance of two pension fund managers, taking into consideration the relative importance of policy, timing and selection, and relevant method of attributing returns to these factors.

Solution:
(a) Describe the simplified framework for return accountability (Brinson’s model).

Commentary on Question:
Candidates performed below average on this section. Many unsuccessful candidates did not identify the four quadrant approach.

Active returns can be broken down into:
- Timing returns
- Selection returns
- Other

The simplified four quadrant approach to return accountability is:

<table>
<thead>
<tr>
<th>(IV) Actual portfolio Return</th>
<th>II Policy and timing return</th>
</tr>
</thead>
<tbody>
<tr>
<td>III Policy and security selection return</td>
<td>(I) Policy return</td>
</tr>
<tr>
<td></td>
<td>Passive portfolio benchmark</td>
</tr>
</tbody>
</table>

(b) Critique the accuracy of the above statement by comparing Manager A and Manager B’s selection return.
7. Continued

Commentary on Question:
Candidates performed as expected on this section. Most points were obtained in the numeric calculation of the managers’ returns. Successful candidates were able to call out that REITs were heavily weighted in the benchmark, and that Manager A underperformed significantly on those.

Manager A is incorrect.
The return due to selection base is:

**Quadrant 1 & III for Manager A**

Quadrant 1 = 7% (ensure work is shown)

\[ 7\% = (0.3*0.08) + (0.3*0.06) + (0.25*0.04) + (0.15*0.12) \]

Quadrant III = 6.68% (Ensure work is shown)

\[ 6.68\% = (0.3*0.078) + (0.3*0.072) + (0.25*0.02) + (0.15*0.112) \]

Selection return = -0.32%

**Quadrant 1 & III for Manager B**

Quadrant 1 = 7% (from above)

Quadrant III = 6.75% (Ensure work is shown)

\[ 6.75\% = (0.3*0.075) + (0.3*0.07) + (0.25*0.03) + (0.15*0.11) \]

Selection return = -0.25%

Based on the above, Manager B’s selection based return is better than that of Manager A, hence Manager A is incorrect in his self assessment. This is primarily because he underperformed significantly on a pretty heavily weighted portfolio of REITS.

(c) Calculate the decomposition of each manager’s active return.

Commentary on Question:
Candidates performed as expected on this section. Successful candidates scored full marks in correctly calculating the decomposition of each manager’s active return.
Manager A’s active return

Quadrant I = 7.0% (From above)
Quadrant II = 7.5% (Ensure work is shown)

7.5% = (0.35*0.08) + (0.25*0.06) + (0.2*0.04) + (0.2*0.12)

Quadrant III = 6.68% (From above)

Quadrant IV = 7.2%

7.2% = (.35*.078) + (.25*.072) + (.2*.02) + (.2*.112)

Timing return = 0.5% (I – II)
Selection return = -0.32% (III – I)
Other = -0.01% ((IV – III – II + I)
Total = 0.17% (sum of the above)

Manager B’s active return

Quadrant I = 7.0% (From above)

Quadrant II = 6.7%

6.7% = (.25*.08) + (.25*.06) + (.35*.04) + (.15*.12)

Quadrant III = 6.75% (From above)

Quadrant IV = 6.3% (Ensure work is shown)

6.3% = (.25*.075) + (.25*.07) + (.35*.03) + (.15*.11)

Timing return = -0.3% (I – II)
Selection return = -0.25% (III – I)
Other = -0.13% ((IV – III – II + I)
Total = -0.67% (sum)
7. Continued

(d) Compare their performance qualitatively using the results from part (c).

**Commentary on Question:**
Candidates performed as expected on this section. Successful candidates correctly identified timing as the driver of better returns, as well as calling out that the security selection did worse than the benchmark.

Manager A’s overall performance is better.

The reasons are:

- Manager A’s timing was better, by over weighting high performing assets in the portfolio relative to the benchmark and compared to the manager B
- Even though A’s security selection did not fare as well compared to the benchmark, A’s timing more than made up for it.
8. **Learning Objectives:**

6. The candidate will understand:
   - Investment dimensions of designing product offerings and managing inforce product liabilities.
   - Managing investment portfolios in the context of financial institution liabilities (asset liability management).
   - The theory and techniques of portfolio asset allocation.

**Learning Outcomes:**

(6c) Demonstrate an understanding of liability driven investing (LDI) for pension plans

(6d) Propose asset allocation strategies and explain the impact of asset allocation relative to various investor goals and constraints

(6e) Develop and critique asset allocation strategies appropriate to underlying liability profiles

(6h) Explain how behavioral characteristics of individuals or firms affect investment management processes

**Sources:**


QFIA-129-18: Equity Indexed Annuities - Downside Protection, But at What Cost?


**Commentary on Question:**

The question tests the candidates understanding of liability driven investing for both individuals and corporations. Overall, candidates performed as expected on the question.

**Solution:**

(a) Calculate the volatility of surplus.

**Commentary on Question:**

Candidates performed poorly on this section of the question. Most candidates did not recognize the correct formula to calculate the volatility of surplus. Candidates did receive some partial credit for attempting to calculate the volatility from first principles.
8. Continued

Use formula (10A.12):

$$
\text{Var}_t\left(\frac{S_{t+1}}{A_t}\right) = \alpha^2 \sigma_E^2 + \left(1 - \alpha - \beta \frac{L_t}{A_t}\right)^2 \sigma_B^2 + 2\alpha \left(1 - \alpha - \beta \frac{L_t}{A_t}\right) \rho \sigma_E^2 \sigma_B^2 \\
= 40\%^2 \times 15\%^2 + \left(1 - 40\% - 1.15 \times \frac{1}{80\%}\right)^2 8\%^2 + 0\% + 2 \times 40\% \left(1 - 40\% - 1.15 \times \frac{1}{80\%}\right) \times 15\% \times 8\% \times 10\% = 0.7285\%$$

The volatility of surplus = 100*80%*√Var_t = 80*8.54% = 6.83

(b) The fund manager is considering a new strategy: Replace the domestic equity fund with a global equity fund because the global fund has a higher Sharpe ratio.

Critique this strategy.

Commentary on Question:
Candidates performed as expected on this section of the question. Candidates that struggled with the question focused on the limitations of the Sharpe ratio rather than critiquing the strategy.

- Global fund has a higher Sharpe ratio, however it also has a lower correlation with the domestic liabilities.
- Due to lack of funds, an underfunded plan cannot eliminate liabilities from the asset allocation problem. The correlation of domestic equity with liabilities is crucial. The funds do not gain from diversification.
- Sharpe ratio ignores the presence of any liabilities. An underfunded plan is better suited to hedge against changes in the value of liabilities.
- Shouldn’t add it solely based on Sharpe ratio.
- Risk Adjusted Change in Surplus (RACS) should be used to evaluate any strategies for this fund.

(c) Many retirees from ABC are worried about the underfunded status of the pension plan. One retiree, Jack, relies heavily on the pension income to cover his living expenses. He sought help from his financial advisor. The advisor recommended to him to invest all of his savings in an Equity Indexed Annuity (EIA) to protect him from further market risks.

Evaluate the advisor’s recommendation.
8. Continued

Commentary on Question:
Candidates performed as expected on this section. Candidates who performed poorly described the limitations of indexed annuities without evaluating the advisor’s recommendation. Candidates that did well discussed why an indexed annuity was not a good fit for Jack.

- EIA provides market downside risk protection.
- EIA may be appropriate for very risk adverse individuals, those who prefer payoffs in recessionary economic states.
- EIA is suitable for individuals with discretionary long-term wealth (but with a great sensitivity to down-side risk).
- The performance of EIA is highly sensitive to the starting and ending dates (positions) of the market. The market has been bearish so the starting value of the fund is low.
- The illiquidity of the contracts makes EIA generally unsuitable for individuals with low levels of wealth such as Jack who depends on receiving pension income for his living expenses. [2 pts] Investing all of his savings in an EIA will significantly reduce the liquidity of his portfolio. There are uncertainties around his pension income due to the plan’s low funding status, so he may not be able to afford the loss of liquidity. Even though Jack is risk adverse, this investment would not meet his liquidity needs.
- In conclusion, the EIA is not a good product for Jack.

(d) You observe that for an overfunded plan fully invested in bonds, moving a small amount of the fund to equities could lead to a decrease in the surplus volatility.

Explain your observation.

Commentary on Question:
Candidates performed as expected on this section of the question. Candidates that performed poorly did not provide an acceptable explanation of the observation.

- Equities and bonds are not perfectly correlated. There are diversification benefits.
- When the funding ratio is very large, liabilities matter little in determining the surplus risk.

(e) Calculate the optimal equity allocation that achieve management’s goal given the new funding status.
8. Continued

Commentary on Question:
Candidates performed above average on this section. Candidates that performed poorly did not identify the correct formula to use. Some candidates that received partial credit identified the correct formula but were not able to determine one of the terms in the formula.

Use formula (10.9). The equity allocation to minimize the surplus risk is:

\[
\left(1 - \beta \frac{L_t}{A_t}\right) \frac{\sigma_B^2 - \rho \sigma_B \sigma_E}{\sigma_E^2 + \sigma_B^2 - 2 \rho \sigma_B \sigma_E} = \left(1 - 1.15 \frac{1}{200}\right) \frac{8\%^2 - 10\% \times 15\% \times 8\%}{15\%^2 + 8\%^2 - 2 \times 10\% \times 15\% \times 8\%} = 8.34\%
\]
9. **Learning Objectives:**

2. The candidate will understand:
   - The credit risk of fixed income portfolios, securities, and sectors and be able to apply a variety of credit risk theories and models.
   - How rating agencies rate corporate and sovereign bonds and securitized credit.

**Learning Outcomes:**

(2a) Demonstrate an understanding of the basic concepts of credit risk modeling such as probability of default, loss given default, exposure at default, and expected loss.

(2h) Demonstrate an understanding of measuring and marking-to-market counterparty credit risk in credit derivatives

(2i) Understand and apply various approaches for managing credit risk in a portfolio setting

**Sources:**

Gregory, Jon, The xVA Challenge: Counterparty Credit Risk, Funding, Collateral, and Capital, 2015, 3rd Edition, Chapter 4, p. 32-36


Gregory, Jon, The xVA Challenge: Counterparty Credit Risk, Funding, Collateral, and Capital, 2015, 3rd Edition, Chapter 4, p. 39-40

Gregory, Jon, The xVA Challenge: Counterparty Credit Risk, Funding, Collateral, and Capital, 2015, 3rd Edition, Chapter 4, p. 28-29

**Commentary on Question:**

*This question tests the candidate’s understanding of CVA, the various ways of calculating CVA, and its uses in practice. Overall, candidates performed below average on this question. In general, candidates had difficulty performing the tested calculations and distinguishing the interactions of credit risk limits and CVAs.*

**Solution:**

(a) Describe the fundamental components used in the measurement of counterparty credit risk.
9. Continued

**Commentary on Question:**
Candidates performed as expected on this part of the question. Most candidates were able to correctly identify the fundamental components used in the measurement of counterparty credit risk but did not offer descriptions of the components.

The components are:

a. Credit exposure – potential principal that could be lost in the event of a counterparty default

b. Default probability – likelihood counterparty not being able to meet its financial obligation

c. Recovery & loss given default – magnitude of loss in the event of a default

(b) Determine an estimate for the implied default probability for each of the first two years, based on the spread curve above.

**Commentary on Question:**
Candidates performed poorly on this part of the question. Most candidates were not able to identify the correct formula used to calculate the implied default probability. Partial credit was given for identifying components of the calculation, such as loss given default.

\[
PD(t_{i-1}, t_i) = \exp(-s_{i-1}t_{i-1}/LGD) - \exp(-s_{i}t_i/LGD)
\]

\[
LGD = 1 - \text{recovery rate} = 1 - 0.3 = 0.7
\]

1 year implied default probability = \( 1 - \exp(-1 \text{ year swap credit spread}/(1-\text{Recovery})) \) = \( 1 - \exp(-2\%/0.7) \) = 2.817%

2 year implied default probability = \( \exp(-1 \text{ year swap credit spread}/(1-\text{Recovery})) - \exp(-2*2 \text{ year swap credit spread}/(1-\text{Recovery})) \) = 0.97183 – 0.92443 = 4.740%

<table>
<thead>
<tr>
<th>Swap</th>
<th>Credit Spread</th>
<th>PD (approx.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1Y Swap</td>
<td>200 bps</td>
<td>2.817%</td>
</tr>
<tr>
<td>2Y Swap</td>
<td>275 bps</td>
<td>4.740%</td>
</tr>
</tbody>
</table>

(c) Describe the use of credit value adjustment (CVA) and credit limits, in managing counterparty risk.
9. **Continued**

**Commentary on Question:**

*Candidates performed below average on this part of the question. Most candidates were not able to describe the complementary nature of CVA and credit limits.*

Credit limits set a limit for counterparty credit risk and works in a binary fashion. It considers risk only.

CVA and credit limits should be used together, since they act in complementary fashion.

CVA considers the return along with the risk. Counterparty risk is “priced in”.

Credit limit quantifies exposure. CVA considers default probability, LGD, and own default probability in addition to exposure.

Counterparty risk should be assessed on three levels: trade, counterparty, and portfolio.

CVA focuses on the trade and counterparty levels and encourages minimizing the number of trading counterparties.

Credit limits act at the portfolio level by limiting exposures to avoid concentrations.

(d) Compare and contrast the use of historical data versus market data for determining appropriate CVA charges.

**Commentary on Question:**

*Candidates performed poorly on this part of the question. Most candidates did not describe the differences in using historical data vs. market data. Rather, candidates described that CVA should be calculated using market data per regulations, which is not directly relevant to what’s being asked in this section.*

CVA represents an expected value of future cash flows, when using historical data, and incorporates some adjustment for risk being taken

CVA charges are comparable to insurance premiums used to create a reserve against counterparty default.

Using market data, CVA is the cost of an associated hedging strategy and are calculated using risk sensitivities of all underlying credit-related variables.

Risk-neutral CVA charges are typically larger than the expected loss CVA calculated using historical data, primarily driven by risk premiums implicit in market-implied parameters.

Risk-neutral CVA is a point-in-time credit risk measure vs. expected loss CVA reflects through-the-cycle expectations of credit risk.
9. Continued

(e) Discuss ways the company can mitigate counterparty risk, noting benefits and drawbacks of each approach.

**Commentary on Question:**
*Candidates performed as expected on this part of the question. Many candidates received only partial credit on this part, since they did not provide explanations on how to use the risk mitigation techniques or the drawbacks of using such techniques.*

a. Netting allows cashflows to be offset and for MTM values to be combined into a single net amount. Creates legal risk if netting agreement cannot be enforced.

b. Collateral agreements specify contractual posting of cash against MTM losses. Creates operational risk due to logistics, market risk re. time to receive collateral, and liquidity risk, since posting of collateral needs to be funded.

c. Hedging with instruments protects against potential default events and adverse credit spread movements. Creates operational risk and additional market risk through mark-to-market volatility of hedging instruments. May also lead to systemic risk through feedback effects.

d. Central counterparties guarantee the performance of transactions cleared through them. Creates operational and liquidity risks, as well as systemic risk, since failure of a central counterparty could lead to systemic disturbance.
10. **Learning Objectives:**

3. The candidate will understand the variety and assess the role of equities in investment portfolios. The candidate will demonstrate an understanding of the distinguishing investment characteristics and potential contributions to investment portfolios of the following major asset groups:
   - Real Estate
   - Public Equity
   - Private Equity
   - Infrastructure
   - Commodities
   - Hedge Funds

**Learning Outcomes:**

(3b) Demonstrate an understanding of the types of equity investments available for an investor’s growth allocation and their most important differences.

(3d) Demonstrate an understanding of the due diligence process for different types of equity investments.

(3g) Explain the basic active equity selection strategies including value, growth and combination approaches, and compare techniques for characterizing investment style of an asset manager.

(3h) Demonstrate an understanding of equity indices and their construction, including distinguishing among the weighting schemes and their biases.

(3j) Describe the core-satellite approach to portfolio construction with a completeness fund to control overall risk exposures.

**Sources:**

**Commentary on Question:**
*This question tests the knowledge of various types of alternative investments.*

**Solution:**
(a) Explain how investing in Company B may benefit your hedge fund.

**Commentary on Question:**
*The candidates performed below average on this section. Most candidates identified that investing in Company B is a distressed security investment. Some candidates identified distressed securities as investment opportunities that could be cheap/undervalued, but in most cases, they did not provide any explanation to support that statement.*
10. Continued

Investing in Company B would be a distressed security investment. Hedge funds invest in bonds and equity of the companies that are in or on the brink of bankruptcy. The hedge fund’s goal is to exploit the fact that many investors are unable to hold below investment grade securities due regulatory or investment policy restrictions and also that analysts often do not cover distressed securities. This leads to unresearched investment opportunities that could be undervalued.

(b) Explain four risks associated with investing in Company B.

Commentary on Question:
The candidates performed as expected on this section. Many candidates identified and explained at least 2 risks associated with investing in Company B. Some candidates listed risks but did not provide explanations of them and therefore received partial credit.

- Event Risk – An unexpected company specific or situation specific risk that might affect the prospects for a distressed securities investment (e.g. Company B can’t fix their safety issues)
- Market Liquidity Risk – Market liquidity for distressed securities is significantly less than other securities (HFV9 may be unable to resell the distressed bonds)
- J Factor Risk – Judge’s track record in adjudicating bankruptcies and restructures
- Market Risk – Changes in economy, changes in interest rates
- HFV9’s investors are actively seeking higher returns – these investors might have a shorter investment time horizon than HFV9, but it might take a long time for the investment in Company B to become profitable.

(c) Describe the management style of your hedge fund.

Commentary on Question:
The candidates performed poorly on this section. Most candidates did not identify the management style as active management. Some candidates identified the management style as active management but provided no description of it and thus received partial credit.

The management style of HFV9 is active management. An active management approach involves corporate activism. The investors buy the debt at deep discount and influences and assists in the recovery or reorganization of the troubled company.
10. Continued

(d) Evaluate this investment opportunity in HFV9 for this family endowment fund.

Commentary on Question:
The candidates performed above average on this section. Most candidates recognized HFV9 could be a good investment opportunity for the family endowment fund. Most candidates recognized the diversification and higher return benefits that distressed securities provide when compared to traditional stock and bond investments. Some candidates correctly noted that the endowment fund has a long investment time horizon, and therefore there is less of a need for liquidity. Unsuccessful candidates typically concluded that this was not a good investment opportunity either because of the illiquid nature of alternative investments or because they thought the investment was too risky for the family endowment fund.

- Investing in distressed securities could provide an attractive strategy for the family endowment fund.
- The family endowment fund has a long investment time horizon, so investing in illiquid assets is not a big concern.
- Distressed securities provide higher returns than traditional stock and bond investments.
- Alternative investments provide a diversification benefit to the fund, as they have a low correlation with traditional stock and bond investments.
11. Learning Objectives:

3. The candidate will understand the variety and assess the role of equities in investment portfolios. The candidate will demonstrate an understanding of the distinguishing investment characteristics and potential contributions to investment portfolios of the following major asset groups:
- Real Estate
- Public Equity
- Private Equity
- Infrastructure
- Commodities
- Hedge Funds

Learning Outcomes:

(3a) Understand how the behavioral characteristics of individuals and firms influence the dynamics of equity markets.

(3b) Demonstrate an understanding of the types of equity investments available for an investor’s growth allocation and their most important differences.

(3d) Demonstrate an understanding of the due diligence process for different types of equity investments.

(3h) Demonstrate an understanding of equity indices and their construction, including distinguishing among the weighting schemes and their biases.

Sources:
Maginn & Tuttle, 3rd Edition, 2007 Ch.8 p 490, 498

Commentary on Question:
This question focused on the considerations and constraints to consider in an IPS of life and non-life insurer under specific constraints.

Solution:
(a) Describe and explain the main differences in the IPS of both life and P&C insurers for each of the following elements:

(i) return objectives

(ii) liquidity requirement

(iii) time horizon
11. Continued

**Commentary on Question:**
The candidates performed below average for part i) the return objectives. Many candidates did not explain the need of return to grow surplus for both insurers and that return is important for long-term premium setting for life insurers but of less concern for P&C insurers.
The candidates performed as expected for part ii) the liquidity requirement. Most candidates recognized that life insurers generally have long term liabilities and P&C insurers generally have short term liabilities. Many candidates did not address the impact of a change in interest rates for life insurers as disintermediation. Many candidates did not address that catastrophic events may require the need to sell assets to meet uncertain claims for the P&C insurers.
The candidates performed as expected for part iii) time horizon. Most candidates recognized that life insurers generally have long term liabilities and P&C insurers generally have short term liabilities. A few candidates recognized the impact on surplus a mismatch of assets and liabilities for life insurers.

(i) return objectives

For life insurance company, we need to match the long-term duration of liabilities of whole life insurance contracts.
Return above average investment return provides competitive advantages in the premium calculation and is needed for growth of surplus.

For P&C, some liabilities are not as much exposed to interest rate risk as for life Insurance company.
Also, even if it is not taken into account in the premium setting, it is also important for the growth of surplus.

(ii) liquidity requirement

For the life insurer, the long-term liabilities are characterized by minimal liquidity.
With the expectation that interest rates will rise, life insurers need to pay attention to liquidity requirements especially with disintermediation aspect associated with policy loans and policy surrender.

Because of the uncertainty of the cash flows and the short-term nature of the liabilities, P&C requires more liquidity.
The cycle nature of business and the possibility for catastrophe events justify the need to sell investments to meet cash flows shortfalls.
11. Continued

(iii) time horizon

For life insurers with long-term nature of liabilities for whole life insurance contracts, the holding period of investment is as long as 20 to 40 years. A mismatch between duration of assets and liabilities can reduce the surplus.

For P&C, the duration of liabilities is usually shorter than those of life insurers. Historically, P&C companies are long-term investors with an objective of growth in surplus using common stock investment.

(b) Explain if such investments are appropriate for both life and P&C insurers by considering the risks associated with (1) cash flow and liquidity requirements, and (2) surplus.

Commentary on Question:
The candidates performed as expected for (1) the risks associated with cash flow and liquidity. Almost all candidates correctly specified investing into alternative assets is a strategy for growth of surplus. Many candidates did not address the impact of the risk associated with policy loan and cash surrender value in the context of rising interest rates for the life insurer. The candidates performed below average for (2) the surplus. Almost all candidates didn't explain the regulatory surplus requirements. Some candidates incorrectly did not recommend alternative assets for life insurers.

(1) cash flow and liquidity requirements

• For life insurer
  With the presence of recent interest rates volatility and expected increase in interest rates, there are concerns in the predictability of cash flows and risks of liquidity. Especially for disintermediation due to policy loan and cash surrender value, there are both important risks. Alternative assets such as commercial properties may provide regular cash flow, but they are relatively illiquid as private equities.

• For P&C insurer
  Since claims are quite erratic and uncertain in both value and timing, investments related to policy reserves must support low risk tolerance for the loss of principal. Alternative assets such as commercial properties and private equities are not easy to be divided to sell for liquidity.
11. Continued

(2) surplus

- For life insurer
  Alternative investments support strategies for the growth of surplus and business volume.
  During a period of rising interest rates, the risk of disintermediation with a large block of whole life insurance contracts, policy loan and cash surrender value may impact on the profitability and the surplus.
  In the US, there is a need to maintain an asset valuation reserve under NAIC and meet a risk-based capital (RBC) requirement from regulators based on the quality test of assets.
  Those requirements may limit investments in common stocks.

- For P&C insurer
  As for life insurers, alternative investments permit to achieve the growth of surplus.
  For P&C insurers, there is no requirement for an asset valuation reserve, but insurers need to monitor the RBC and the ratio of premiums to capital and surplus.
  The actual ratio of 5 to 1 exceeds the usual maximum of 3 to 1. This may limit the capacity of risk taking.

For all those considerations of risks related to cash flows, liquidity and surplus, I do not recommend alternative investments in commercial properties leasing and private equities.
12. Learning Objectives:
3. The candidate will understand the variety and assess the role of equities in investment portfolios. The candidate will demonstrate an understanding of the distinguishing investment characteristics and potential contributions to investment portfolios of the following major asset groups:
   - Real Estate
   - Public Equity
   - Private Equity
   - Infrastructure
   - Commodities
   - Hedge Funds

Learning Outcomes:
(3b) Demonstrate an understanding of the types of equity investments available for an investor’s growth allocation and their most important differences.
(3e) Demonstrate an understanding of the basic concepts surrounding passive, active, and semi-active investing.
(3h) Demonstrate an understanding of equity indices and their construction, including distinguishing among the weighting schemes and their biases.
(3i) Recommend and justify, in a risk-return framework, the optimal portfolio allocations to a group of investment managers.

Sources:
Maginn & Tuttle, Managing Investment Portfolios, 3rd Edition, 2007; Ch. 7

Commentary on Question:
This question tests the concepts of index portfolio construction, weighting, and the appropriateness of each for a given situation. Also asks the candidate to consider active vs. passive management.

Solution:
(a) Describe the four weighting methods for creating the index.

Commentary on Question:
The candidates performed brilliantly on this section. Only a few candidates were not able to identify and describe the weighting methods.

- Price Weighted - buys one share of each stock
- Value Weighted (or Market Cap Weighted) - replicates owning all the outstanding shares of each company
- Float Weighted – same as Value Weighted, but only uses shares that are available for trading
- Equal Weighted - same amount of money invested in each company
12. Continued

(b) Compute the 2018 index return under each of the four methods.

**Commentary on Question:**
The candidates performed above average on this section. Some candidates did not modify the Price Weighted and Equal Weighted formulas to account for the stock split, but still received partial credit.

Price Weighted = \frac{(180 + 12 + 123 + 31*2)}{(175 + 13 + 76 + 55)} – 1
\[
\frac{377}{319} – 1 = 18.2\%
\]
Value Weighted = \frac{(9.0 + 1.2 + 123 + 12.4)}{(8.75 + 1.3 + 76 + 11)} – 1
\[
\frac{145.6}{97.05} – 1 = 50.0\%
\]
Float Weighted = \frac{(9.0 + 1.2 + 123*.6 + 12.4)}{(8.75 + 1.3 + 76*.6 + 11)} – 1
\[
\frac{96.4}{66.65} – 1 = 44.6\%
\]
Equal Weighted
Return A = \frac{180}{175} – 1 = 2.9%
Return B = \frac{12}{13} – 1 = -7.7%
Return C = \frac{123}{76} – 1 = 61.8%
Return D = \frac{31*2}{55} -1 = 12.7%
\[
\frac{.029 -.077 + .618 + .127}{4} = 17.4\%
\]

(c) Recommend which weighting method would be most appropriate for this index.

**Commentary on Question:**
Candidates performed as expected on this section. Most recommended float-weighted, but not all explained why float weighted is preferred over other methods. Credit was given for other methods recommended, as long as logical justification was provided, and compared against the other methods.

Recommend Float Weighted
Price Weighted would weigh Tech A too high
Value Weighted would overweight Tech C, and 40% of those shares cannot be purchased
Equal Weighting puts too much emphasis on Tech Y, the smallest in the index

(d) Recommend a method for constructing each of the two passive index funds.

**Commentary on Question:**
Candidates performed above average on this section. Most got this correct and received full credit. Some candidates recommended a weighting method for each, and received no credit.

DJIA – small number of stocks and highly liquid
Recommend full replication – every issue in the index is represented in the portfolio, with the same weights as the index.
12. Continued

Russell 2000 – many stocks, some may be illiquid
Recommend stratified sampling (representative sampling, or optimization) –
manager divides index along a number of dimensions; assigns each stock to a cell;
finds sample stocks for each cell

(e) Assess whether hiring an active manager for the Tech sector would benefit your
client.

Commentary on Question:
Candidates performed as expected on this section. Full credit was given for a
recommendation along with several supporting statements to justify the
recommendation. Full credit was also given for a passive management
recommendation, with justification. Almost all candidates received some credit
for this part.

Recommend active management
Tech sector is relatively new, so manager could add value by identifying
companies better positioned to outperform going forward.
Tech sector is prone to bubble, so using passive management gets you sucked into
a bubble
Capable managers may be able to identify undervalued/underperforming
companies in Tech sector

OR

Recommend passive management
Active management would likely not add much value
So few stocks in the index that passive replication would be easy
Deviating from the stocks in the index would add tracking error
The added cost from a manager probably not worth it
13. **Learning Objectives:**

3. The candidate will understand the variety and assess the role of equities in investment portfolios. The candidate will demonstrate an understanding of the distinguishing investment characteristics and potential contributions to investment portfolios of the following major asset groups:
   - Real Estate
   - Public Equity
   - Private Equity
   - Infrastructure
   - Commodities
   - Hedge Funds

7. The candidate will understand the need for and goals of attributing the performance of a portfolio to various factors, evaluating this attribution against a benchmark, and recommending adjustments to portfolio strategy.

**Learning Outcomes:**

(3g) Explain the basic active equity selection strategies including value, growth and combination approaches, and compare techniques for characterizing investment style of an asset manager.

(3i) Recommend and justify, in a risk-return framework, the optimal portfolio allocations to a group of investment managers.

(7b) Describe and assess techniques that can be used to select or build a benchmark for a given asset, portfolio

**Sources:**
Maginn & Tuttle, Managing Investment Portfolios, 3rd Edition, 2007; Ch. 7

Maginn & Tuttle, Managing Investment Portfolios, 3rd Edition, 2007; Ch. 12
Lo, What is an Index?

**Commentary on Question:**
*This question tests a candidate’s knowledge of active manager style, and asks them to assess whether managers that deviate from the benchmark are a good fit for their overall portfolio.*

**Solution:**

(a) Describe four criteria for evaluating benchmarks.

**Commentary on Question:**
*The candidates performed poorly on this section. While some candidates provided answers that received full credit, many candidates provided properties of a valid benchmark while the question was referencing criteria used to distinguish benchmark quality.*
13. Continued

Systemic biases – good benchmark will have statistically significant positive correlation coefficient between style and difference between account and market index
Tracking error – good benchmark should reduce “noise” in performance evaluation process
Risk characteristics – good benchmark will exhibit risk exposures at times greater and at times smaller than those of the managed portfolio
Coverage – benchmark coverage defined as proportion of portfolio market value contained in benchmark
Turnover – proportion of benchmark market value allocated to purchases
Positive active positions – active position is account’s allocation to a security minus the corresponding weight of the same security in the benchmark

(b) Describe ways of dealing with backtest bias.

Commentary on Question:
The candidates performed poorly on this section. Few candidates provided answers that received full credit. Some candidates provided answers that described general qualitative items related to manager due diligence.

Treat all performance records with a healthy dose of skepticism (Most obvious)
Use additional information to distinguish theta, the Sharpe ratio, from epsilon, the estimation error
Most direct way to distinguish theta from epsilon is conduct live out-of-sample experiments

(c) Assess the styles of manager X and Y and the appropriateness of their benchmarks.

Commentary on Question:
The candidates performed as expected on this section. Some candidates mis-identified the styles of the Managers from the information given, for example, stating that a growth style manager would be overweight in utilities.

For manager X:
Russell 1000 competes with the S&P 500 as a benchmark for large cap stocks
Started a small-cap growth oriented
Ended as market oriented large cap, with a slight bias toward value
Style drift is pretty severe
Returns based analysis may be ineffective in characterizing current style
Benchmark not good fit for Manager X
13. Continued

For manager Y:
Market cap / number of stocks indicates Manager Y favors small cap stocks
Dividend Yield leans toward growth orientation
P/E leans toward growth
EPS higher indicates a slight lean toward growth
Lower Tech weight leans Value
Higher Financials leans Value
Higher Health Care leans Growth
Higher Utilities leans Value
But, sector weights should be used with caution – very sensitive to the business cycle
Manager Style is Small Cap Growth, which means that Y is not a good fit for S&P500 benchmark

(d) Recommend which manager X or Y is a better fit for the portfolio.

Commentary on Question:
The candidates performed as expected on this section. Many candidates correctly calculated and used the information ratio to determine Y as the better performing manager. Some candidates received partial credit for providing well-reasoned recommendations for or against a certain manager that did not reference the information ratio.

Use information ratio (IR) to assess performance relative to benchmark (active return / tracking risk = information ratio)

For manager X,
IR = 1.5 / 6.0 = .25, low for an active manager
Not a good fit
Not adding enough value, paying the fees, could go index instead, concerned about the drift

For manager Y,
IR = 6.0 / 7.0 = .85, high for an active manager
Manager Y is considered a high performing manager given the high IR result above, but the style analysis from part c) as small cap growth means that Y is not good fit for S&P500 benchmark which is large cap so do not keep Y.
Or Manager Y is high performing manager worth keeping, but the benchmark should be changed to better reflect the style of manager Y (small cap growth) while S&P 500 is large cap benchmark
14. **Learning Objectives:**

1. The candidate will understand how to work with the variety of fixed income instruments available for portfolio construction.

**Learning Outcomes:**

(1a) Describe the cash flow of various corporate and sovereign bonds considering underlying risks such as interest rate, credit and event risks.

(1h) Construct and manage portfolios of fixed income securities using the following broad categories:

- Managing funds against a target return
- Managing funds against liabilities

**Sources:**

Fabozzi, Frank J. *Fixed Income Securities*, 8th Edition, Chapter 12, and 18

**Commentary on Question:**

*This question tests candidates’ knowledge in fixed income assets credit spread risk and inflation indexed bonds, and applications of the knowledge in asset liability management.*

**Solution:**

(a) A Portfolio Manager makes the following statement: “A corporate bond’s credit spread is the difference between the corporate bond’s yield and the yield on a comparable-maturity benchmark Treasury security. Credit spread risk is the risk of the bond defaulting. Thus once you know the spread, you know the bond’s default risk.”

Critique the portfolio manager’s statement.

**Commentary on Question:**

*Candidates performed brilliantly on pointing out that credit spread reflects not only default risks, but also other risks. However very few candidates gave correct definition of credit spread risk*

1. Manager’s statement is not correct.
2. Credit spread risk is the risk of financial loss of a portfolio resulting from the changes in the level of credit spread used in the marking-to-market of a fixed income security.
3. The credit spread of a corporate bond is due to corporate bonds’ exposure to not only credit (default) risk, but also other risks, including liquidity, embedded options, etc..

(b) Calculate the coupon payments during the first year after issuance under the provided assumptions.
14. Continued

**Commentary on Question:**
Candidates performed above average on this question. Most candidates demonstrated good understanding of how inflation affects cash flows of inflation-indexed bonds.

First semi-annual coupon:
Principal at end of six months = 1,000,000 \* (1 + 2\%) = 1,020,000
Coupon = 1,020,000 \* (1\% / 2) = 5,100

[2 pts] Second semi-annual coupon
Principal at end of first year = 1,020,000 \* (1 + 4\%) = 1,060,800
Coupon = 1,060,800 \* (1\% / 2) = 5,304

(c) Calculate the approximate nominal yield of the bond.

**Commentary on Question:**
Candidates performed as expected on this question. Full credit were also given for considering the first year inflation rate as 0.404\% and 0.0808\% as given in the question.

Since the bond is priced at par, the real yield = the coupon
TIPS realized nominal yield = (1 + real yield)*(1+inflation) - 1[2 pts]
[2 pts] (1 + 1\%)*(1 + 3\%) – 1 = 4.03\%

(d) Analyze the likely impact on the duration match between the asset portfolio and liabilities if the substitution is made.

**Commentary on Question:**
Candidates performed as expected on the relationship between effective duration and real duration, but poorly on pointing out the risk of future duration mismatch from including inflation-indexed bonds in the asset portfolio due to that effective and real duration are not perfectly co-related.

1. The effective (nominal) duration of the asset portfolio will likely become shorter/asset duration will likely be shorter than liabilities, OR, liability duration will likely be longer than assets.
2. TIPS (inflation-indexed bonds) effective duration is 75\% of real duration, OR, inflation-indexed bonds effective duration is shorter than real duration
3. The risk of a potential duration mismatch in the future is greater as real and effective durations are not perfectly co-related
14. Continued

(e) Compare break-even inflation rate with risk-adjusted break-even inflation rate.

**Commentary on Question:**
*Candidates performed above average on explaining breakeven inflation, but poorly on explaining risk-adjusted break-even inflation rate. Very few candidates demonstrated understanding of inflation risk premium.*

1. The break-even inflation rate is the rate that results in TIPS having the same yield as a nominal bond of same maturity.
2. The risk-adjusted break-even equals the break-even inflation rate minus an inflation risk premium.
3. Conventional (nominal) yield includes inflation risk premium, at least part of which is not included in TIPS real yield.
15. **Learning Objectives:**

4. The candidate will understand the nature, measurement and management of liquidity risk in financial institutions.

**Learning Outcomes:**

(4a) Demonstrate an understanding of the concept of liquidity risk and the threat it represents to financial intermediaries and markets.

(4c) Demonstrate an understanding of the levels of liquidity available with various asset types and the impact on a company’s overall liquidity risk.

(4h) Create liquidity risk management plans and procedures, including addressing appropriate product design, investment guidelines, and reporting given a desired liquidity risk level.

**Sources:**
Bluhm, An Introduction To Credit Risk Modeling 2nd Ed, chapter 1

Fabozzi, Handbook of Fixed Income Securities, chapter 66, p. 1545

Shin, Reflections on Northern Rock: The Bank Run that Heralded the Global Financial Crisis, p. 116

Gregory, The xVA Challenge, The xVA Challenge: Counterparty Credit Risk, Funding, Collateral and Capital, p. 6

Report of the American Academy of Actuaries’ Life Liquidity Working Group, p. 10

**Commentary on Question:**
The question tested the concepts of credit and liquidity risks in the context of a letter of credit and potential call on assets it could cause. Candidates are asked to review the interaction of credit and liquidity risks as well.

**Solution:**

(a) Calculate expected loss to ABC.

**Commentary on Question:**
The candidates performed above average on this section. Almost universally calculating an expected loss though sometimes not taking survivorship into year two into account in the calculation.

The expected loss is the product of the probability of default, loss given default, and exposure. Over two years this is 0.1 x (1 – 0.7) x 1,000 x 20% + (1 – 0.1) x 0.1 x (1 – 0.7) x 1,000 x 50% = 19.5
15. Continued

(b) Describe ways ABC can mitigate liquidity risk created by the LOC.

**Commentary on Question:**
*The candidates performed below average on this section. Often elaborating on the topic of liquidity risk and not recognizing the risk associated with holding a letter of credit.*

The LOC increases liquidity risk for the bank as there can be a demand for 1,000 million on short notice. Mitigate this by purchasing derivative instruments and liquidity backstops (insurance, synthetic GICs).

(c) Explain how a credit default swap can mitigate ABC’s credit risk.

**Commentary on Question:**
*The candidates performed as expected on this section.*

XYZ could default due to its credit quality, a CDS contract would protect ABC in case of this event in exchange for regular premiums. This does not eliminate credit risk it only reduces it.

(d) Calculate the fixed rate ABC would pay for a 2-year credit default swap if the counterparty’s profit is 1%.

**Commentary on Question:**
*The candidates performed below average on this section. Some unsuccessful candidates used a swap logic more complicated than required and arrived at an illogical answer.*

Profit is 1% of the 19.5 from part a, or 1.01 x 19.5 / 2 or 9.8475 per year, this is equal to 98bps of the $1,000 premium.

(e) Discuss how the risk management actions of individual firms can lead to increased credit and liquidity risks for the financial system.

**Commentary on Question:**
*The candidates performed as expected on this section. Typically recognizing a potential credit or liquidity crisis but not seeing a correlation.*

A CDS hedges an individual firm's credit risk but does not reduce the total credit risk in the financial system and increases risk of contagion. Firms will reduce lending and hold cash in a credit crisis, reducing their liquidity risk and causing a liquidity shock due to lack of funding.
16. Learning Objectives:

2. The candidate will understand:
   - The credit risk of fixed income portfolios, securities, and sectors and be able to apply a variety of credit risk theories and models.
   - How rating agencies rate corporate and sovereign bonds and securitized credit.

Learning Outcomes:

(2f) Demonstrate an understanding of and be able to apply the concept of Duration Times Spread (DTS)

(2i) Understand and apply various approaches for managing credit risk in a portfolio setting

Sources:
QFIP-130-19: Default Risk and the Effective Duration of Bonds

Commentary on Question:
This question tests the candidates’ understanding of basis risk and its application to effective duration calculations in asset-liability management.

Solution:

(a) Define basis risk within the context of fixed-income portfolios.

Commentary on Question:
The candidates performed below average in this part. While most candidates explained basis risk as some kind of mismatch between a fixed income instrument and a hedge or a mismatch between assets and liabilities, the spread between yields was seldom identified.

Basis risk is the risk attributable to uncertain movements in the spread between yields associated with a particular financial instrument or class of instruments and a reference interest rate over time.

(b) Identify four major types of basis risk.

Commentary on Question:
The candidates performed poorly in this part. Rather than give specific examples of basis risk by contrasting two fixed income instruments, many candidates listed other kinds of risks that didn’t correspond to basis risk.
Major types of basis risk are:

a. Spreads between long-term and short-term financial instruments
b. Spreads between domestic and foreign currencies
c. Spreads between liquid and illiquid investments
d. Spreads between bonds of high versus low duration and convexity

Any of the above may be replaced by:
e. Spreads between taxable and tax-free instruments
f. Spreads between spot and futures contracts
g. Spreads between default-free and risky securities

(c) Determine the effective duration of surplus (Z).

Commentary on Question:
The candidates performed above average in this part. Many candidates obtained the correct value for Z often using a different methodology than shown below and received full credit. Candidates got partial credit for computing just X and/or Y correctly.

V = 0.90*12 = 10.8, \[ W = 0.81*10 = 8.1 \]
X = \( \frac{5}{9} \times (0.90*12) + \frac{4}{9} \times (0.81*10) \) = 9.6
Y = 11*1.10 = 12.1
Z = \( \frac{90}{15} \times 9.6 - \frac{75}{15} \times 12.1 \) = –2.9

(d) Justify the use of each basis risk adjustment factor and its magnitude.

Commentary on Question:
The candidates performed below average on this part. Very few candidates identified reasons a and b below. Some candidates provided valid explanations by considering the default risk of different bonds.

We address them sequentially:

a. Yields on AA-rated bonds fluctuate less than corresponding Treasury bonds. Effective duration of corporate bonds is empirically found to be less than their Macaulay duration.
b. Yields on BB-rated bonds fluctuate less than corresponding Treasury bonds. Moreover, data show that the riskier the bonds, the less sensitive they are to changes in interest rates.
c. The effective duration of liabilities is more than their Macaulay duration based on the discount rate of assets. The appropriate discount rate is closer to the Treasury rate.

Alternative explanation for effective duration of assets: Incorporation of the effect of default (or credit risk) reduces the effective duration of the bonds. Riskier bonds have higher credit risk and therefore the duration adjustment is greater.
16. Continued

(e) Your manager states that adjusting the liabilities’ duration is not sufficient to account for basis risk and that the value of liabilities may be also understated. Explain why this statement may be true.

Commentary on Question:
The candidates performed poorly on this part. Many candidates provided speculative answers of why the manager’s statement may be true but had no connection to the question and thus received no credit. Some candidates disagreed with the manager’s statement or saw no evidence for it and also received no credit.

If the liabilities are discounted at an appropriate rate (not the blended discount rate of the assets) then their current value is likely to be higher.

(f) Estimate the value of surplus after a 50 basis point drop in the 10-year Treasury bond yield.

Commentary on Question:
The candidates performed below average on this part. Common mistakes were getting the sign of the surplus change wrong or missing the fact that with a correct value of the liabilities of 80, the surplus is now 10.

Perform the following calculations:
a. Revised value for Z = (90/10)*9.6 – (80/10)*12.1 = –10.4
b. Interpretation of effective duration = 1% drop in the benchmark interest rate will result in 10.4% drop in the value of the surplus
c. Surplus after 50 basis points drop = 10*(1–10.4%*50%) = 9.48.
An alternative calculation is to compute the change in assets and liabilities directly:
a) Change in assets = 90 * (9.6% * 50%) = 4.32
b) Change in liabilities = 80 * (12.1% * 50%) = 4.84
c) Change in surplus = 4.32 – 4.84 = –0.52 therefore surplus after 50 basis points drop = 9.48.